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Eugenix® Indigenous Ecology

Uranium Nuclear Power Reactors Cooling Water Supply Shortage

1. Abstract.

Uranium nuclear power plants in opposite to Thorium power plants require a lot of water to operate. Uranium power plant in Paks, Hungary has been recently shutdown due to lack of primary water supply from Danube River required for plant operations. In addition, uranium power plant in Paks, as most uranium plants around the world did not anticipate a need for secondary water supply to operate plant's emergency shutdown operations and production of power for critical operations tied into the plant electric power grids. Uranium plants might never be converted into thorium power plants unless such possibilities are explored, but secondary water supply for Paks emergency operations thanks to nature is nearby and should be connected to existing plant water intake.

2. Introduction.

American Nuclear Watchdog prevents Safe Nuclear Power Solutions to UN Member states that develop and operate nuclear programs based on uranium. Non-Uranium options such as Thorium Nuclear Power are a safe alternative to all UN Member states especially in the present time of climate change that affects fresh water supply to cool down nuclear power plants that comes from lakes and rivers as the water for Paks uranium nuclear power plant that cannot be relied upon and secured. States that need energy for critical applications such as water treatment, water purification, water desalination, emergency health care services, critical pharmaceutical production, critical agriculture production should be supported in access to thorium power program thru United Nations Security Forces. Thorium-based nuclear power is widely recognized as cleaner, safer, more abundant, and not associated with uranium-based weapons production.

Dry regions face enormous energy demand, especially for water desalination, water purification, healthcare services, and agriculture. Thorium energy could provide stable, long-term power for these critical needs. Dry regions do not have enough low temperature fresh water to cool down uranium power plant operations therefore thorium power is the only nuclear option that should be allowed in non-polar regions. The United Nations should establish a global nuclear policy enabling states with energy needs to access thorium power secured and managed exclusively by UN security forces composed of personnel from all UN member states.

3. Paks Plant Water Situation.

Paks Uranium Nuclear Power Plant, located 120 kilometers (74.5 miles) south of Hungary capital city Budapest, uses water from the Danube River to cool its reactors. The **plant provides more than 40% of Hungary's electricity generation**. The Danube River water level in many areas including the area of the Plant water intake have fallen to record low levels after months of below-average rainfall and successive heatwaves that continued since May 2026. Record-low water levels on the Danube forced the Paks plant offline, leaving Hungary facing a potential power shortage. In neighboring Serbia, energy production at two hydroelectric plants has also been reduced.

4. Paks Plant Power Production Water Consumption.

The **Paks Nuclear Power Plant** in Hungary operates four VVER-440/V213 reactors. While initially rated at 440 MW each, technical upgrades have successfully increased their output to approximately **500 MW per reactor**, totaling a plant capacity of 2,000 MW.

Total Plant Usage: When all four reactors are operating at full capacity, the entire plant utilizes a "once-through" cooling system that draws approximately **100 m3/sec** of water directly from the Danube River.

Per-Reactor Usage: Assuming an equal baseline distribution across the four identical units, each 500 MW reactor requires roughly **25 m3/sec** of cooling water to condense steam and sustain full power operations.

5. Paks Plant Shutdown Time Required.

In nuclear engineering, a distinction must be made between halting the nuclear chain reaction and fully cooling down the plant. **Emergency SCRAM** (Immediate Stop) If an urgent safety issue arises, dropping the control rods into the reactor core terminates the fission chain reaction within **2 to 4 seconds**.

Controlled / Complete Operational Shutdown: To completely shut down the reactors from full operating mode to a safe, cold shutdown state, operators execute a gradual process over **24 to 72 hours**. This cautious timeline prevents thermal shock and damage to the heavy steel reactor pressure vessels and primary circuit piping.

6. Paks Plant Shutdown Water Consumption.

Once fission ceases, the uranium fuel rods continue to generate immense "decay heat" that must be continuously cooled to prevent core damage. However, because the turbines are no longer producing electricity and the main steam condensers are bypassed, the fluid volume required drops drastically:

Flow Rate Drop: The total water requirement for the entire plant plunges from **100 m3/sec** down to roughly **5 m3/minute to 7 m3/second**, depending on the exact stage of the residual heat removal process and spent fuel pool cooling needs.

Calculated Water Consumption Volume: During the initial **24-hour** critical cooling window following a complete operational shutdown, a conservative baseline flow of **5 m3/minute** translates to a minimum requirement of **7,200 m3 of water per day** for the plant to safely carry away residual decay heat.

7. Paks Plant Primary Water Supply.

The historical data for the Danube River's flow rate near the Paks Nuclear Power Plant over the past 6 months reflects an extraordinary environmental trajectory. While the river normally averages a healthy baseline of **2,000 to 2,500 m3/sec** annually, the past year has been defined by extreme, historic hydrological volatility. The table below tracks the estimated monthly average discharge rates (m3/sec) of the Danube River flowing past the Paks region from late 2025 through August 2026:

Month	Estimated Avg Flow Rate (m3/sec)	Hydrological Context & System Impact
February 2026	~2,500 m3/s	High baseline flow sustained by early seasonal rains.
March 2026	~3,200 m3/s	**Peak Annual Highs:** "Rain-on-snow" alpine melting events cause rapid surging.
April 2026	~2,800 m3/s	Normal spring runoff.
May 2026	~2,100 m3/s	Fast approaching summer.
June 2026	~1,400 m3/s	Rapid drop due to early heatwaves and lack of alpine rainfall.
July 2026	~850 m3/s	**Historic Crisis:** Flow plummeted far below the usual ~2,000 July norm. Flow in nearby Budapest bottomed out at just **723 m3/sec.**
August 2026	~1,000 m3/s	**Slight Recovery:** The river remains severely low and has begun climbing incrementally by rainfall in the upper parts of the river.

Due to an intense, prolonged heatwave across Eastern Europe, the Danube's water levels fell so low that Paks' underwater suction nozzles physically struggled to reach the water column. On **August 1, 2026**, the plant was forced to initiate its first **full operational shutdown** in its 44-year history. Long-term hydrological analysis indicates that climate-driven droughts are heavily compounded by structural engineering issues. The physical riverbed at Paks has been steadily degrading and deepening over the last four decades.

This means that even when the Danube carries a statistically normal volume of water, the physical surface level of the river sits **lower than it did in the 1980s,** inherently worsening the plant's operational risks during severe summer droughts. The next year and the following years annual rain cycle patterns might cause the situation in which the Paks plant will not be able to operate for long periods of time due to lack of stable and predictable primary water supply.

8. Paks Plant Secondary Water Supply.

Lake Balaton holds approximately **1.9 km3 (1.9 billion cubic meters)** of fresh water. The lake has a massive surface area but is uniquely shallow. It averages just **3.3 meters** deep. Its deepest point at the *Tihany Chasm* reaches **12.2 meters.** This shallow profile makes the total volume highly susceptible to rapid evaporation during severe heatwaves. Lake surface area covers roughly **600 km2** (230 square miles). The lake stretches **77 to 78 kilometers** long along its main axis. Its width fluctuates between **4 kilometers and 15 kilometers** at its widest stretches.

The perimeter spans approximately **195 to 235 kilometers** of coastline. Lake Balaton sits roughly **70 kilometers north** of the Paks Nuclear Power Plant and requires a driving distance of approximately **108 km to 162 km**, depending on shore of departure. Despite their regional proximity, Lake Balaton does not directly supply cooling water to Paks, which relies exclusively on the Danube River.

The Sió Canal that allows for the outflow of the Lake Balaton excess water serves as the exclusive, fully artificial, and heavily regulated discharge gateway for Lake Balaton. It handles lake overflow and funnels 124 kilometers southeast directly into the Danube River. Average Discharge of the canal's multi-year historical average at its mouth is **39 m3/sec** that is **39% of required water** to cool down **Paks 4 reactors.** Following recent modernization projects, its control locks can handle a peak deluge flow of up to **100 m3/sec** during high-water emergencies.

There is no "natural" continuous flow in the upper section of the canal. Water only moves significantly when the **Siófok lock gates are intentionally opened by engineers.** Due to the intense, historic European drought, the outflow metrics for the canal over the past year have deviated dramatically from long-term baselines. Because Lake Balaton's water levels fell below standard operating parameters, the water authority completely locked the main drainage gates to preserve lake volume. By late July 2026, Lake Balaton's gauge level plunged to a critically **shallow 56 to 59 centimeters** due to never dredged depth of the lake.

The only outflow allowed in the past several months was a tiny, brief opening on **July 21–22, 2026**. Operators released a rigid total of **150,000 m3** of water, averaging a fraction of a cubic meter per second over a brief window. This emergency flush was executed solely to treat and refresh stagnant water trapped in the **2-kilometer urban stretch** passing through the town of Siófok.

9. Paks Plant Secondary Water Delivery.

The proposed solution involves intercepting water in the upper Tolna region near **Németkér** (located roughly 20 km northwest of Paks) by drawing from the Sió Canal's drainage network, establishing a pumping hub, and constructing a dedicated high-capacity pipeline or canal directly to the plant's intake system. As established in previous sections, a single running reactor at Paks requires **25 m3/sec** for operational cooling, and the entire plant requires **100 m3/sec.** Moving **25 m3/sec** across 20

kilometers of undulating terrain from Németkér to Paks requires an array of ultra-large 3-meter wide diameter pipes and continuous electrical power to run the pumping stations. Constructing an open gravity or forced canal through the Tolna hills would require less extensive land expropriation, short distance deep trenching, but would suffer evaporation losses during the exact summer heatwaves when the water is needed most.

While pumping water from Németkér to run the plant at full capacity is highly inefficient, **the proposal is highly viable as a nuclear safety backup**. When the plant is completely shut down, its decay heat removal system requires a baseline drop to just **5 m3/min**. Pumping smaller, critical safety volume over 20 kilometers is highly realistic. It guarantees that even if the Danube River dries completely, a secondary water line from the Balaton-Sió basin can indefinitely prevent a meltdown.

Dredging Lake Balaton to increase emergency water volume, creates additional buffer to supply this emergency water to Paks power plant when the water from Danube is less accessible. Lake Balaton holds 1.9 billion m3 of water, but its ultra-shallow **3.3-meter average depth** means it loses vast quantities to evaporation during heatwaves. Sediment removal and targeted dredging in the southern or eastern basins could theoretically lower the lake bed allowing it to hold hundreds of millions of additional cubic meters of water without expanding its shoreline footprint. This expansion can be integrated into broader regional agricultural irrigation and drought-mitigation infrastructure projects for the upper Tolna region for the events of long drought and smaller ground water supply.

10. Paks Plant Secondary Water Supply Cost.

The proposed **Balaton-Paks Emergency Waterway Project** represents a regional infrastructure undertaking with an estimated capital expenditure ranging between **€490 million and €810 million.** The foundational element of this system is the construction of a **20-kilometer, high-capacity open canal** stretching from a newly engineered interception basin near Németkér directly to the Paks Nuclear Power Plant. To ensure the Sió Canal can handle such massive volume, a multi-year phased cleanup, mechanical dredging, and bank reinforcement program spanning the **120-kilometer canal bed** would be required to eliminate decades of accumulated silt and vegetative choking.

Because water cannot naturally flow uphill to the Paks plateau, a substantial mechanical lifting infrastructure must be integrated into the system. Powering the massive array of industrial vertical turbine

pumps required to move cooling volume of water would demand an independent megawatt electrical grid upgrade. To safely manage and release the emergency water volume from its source without risking regional flooding, significant **upgrades to Lake Balaton's infrastructure** along the southern and eastern shores such as upgrading the automated mechanical gates at the Siófok lock and installing extensive rock armoring to protect the modified coastlines from severe wave erosion would have to be completed.

11. Burden of Uranium Power Plants.

The recurring cooling crises at the Paks facility highlight a broader, systemic vulnerability inherent to traditional nuclear infrastructure, which can be categorized as the unique operational burden of uranium-based power plants. **Conventional uranium reactors**, including the VVER-440 design utilized at Paks, operate on a high-pressure solid-fuel cycle that demands massive, uninterrupted volumes of water to continuously remove decay heat and prevent catastrophic core meltdown.

This rigid hydraulic dependence stands in stark contrast to emerging liquid-fueled thorium power alternatives, such as molten salt reactors. Thorium-based systems possess passive safety profiles that can utilize ambient air cooling or self-regulating thermal drain tanks, completely eliminating the need for proximity to massive river systems and insulating power generation from continental hydrological crises. Because **uranium reactors lack this technological flexibility**, they remain fundamentally chained to their water sources, leaving facilities globally exposed to the accelerating impacts of climate volatility.

Faced with this reality, the operators of the Paks Nuclear Power Plant have arrived at a critical crossroads where they must choose between three distinct strategic pathways to secure the nation's energy grid. **The first option is to continue** operations under the status quo, accepting the escalating financial and operational penalties of seasonal droughts, curtailing power output during heatwaves, and relying on short-term tactical maneuvers when the Danube River recedes. While this avoids immediate capital expenditure, it leaves Hungary’s baseload electricity supply increasingly vulnerable to unpredictable environmental disruptions.

Alternatively, the operators can execute the ambitious engineering strategy of tapping into Lake Balaton via the proposed Sió Canal and Németkér interception network. While this infrastructure guarantees a multi-year emergency safety buffer capable of preventing a total meltdown even during an

absolute hydrological failure, it triggers severe economic, logistical, and environmental burdens, potentially degrading Central Europe's largest freshwater ecosystem to save an aging industrial asset.

The final path requires bypassing the Balaton basin entirely to install alternative forms of structural protection against Danube droughts. This would involve digging deep, dedicated underwater intake wells directly into the Danube's bedrock, constructing massive closed-loop mechanical cooling towers to replace the current once-through system, or establishing deep-water reservoir basins adjacent to the plant. **Ultimately, Hungarian energy planners** cannot afford to delay this decision, as the burden of uranium power ensures that a failure to secure a resilient, climate-insulated cooling source will inevitably result in the forced retirement of the nation's primary source of carbon-free electricity in 2037 without planned **Russian-backed Paks II** expansion project (**units 5 and 6**) planned to operate into the **2050s** to maintain Hungarian electric grid stability.

12. Final Thoughts.

The Chernobyl disaster poisoned **the ecosystem of 4,500 square kilometers**. The monetary loss directly tied Uranium Nuclear Power place the cumulative historical cost of the Chernobyl disaster at **$235 billion to upwards of $700 billion dollars –** much more than **proposed 810-million-euro** project that enables **emergency water supply from lake Balaton** via Sió basin. Please support **Eugenix P.S.A.** indigenous climate and ecosystem protection and restoration programs developed and managed by **Arcticus Blancus** – native and indigenous climate polar hair ethnic group.

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